

mode of proceeding, he has fallen into a series of errors, many of which I have pointed out in my "Notes on the Arrangement of Sponges, &c." in the 'Proceedings of the Zoological Society' for February, 1868, but which are too numerous to reiterate on the present occasion.

Burrowing Annelids.

To the Editors of the Annals and Magazine of Natural History.

GENTLEMEN,—In Dr. W. C. McIntosh's paper on the boring of certain Annelids, in the 'Annals' for October 1868, p. 276, several Annelids are mentioned as burrowing, although I showed, several years ago, that two of the genera enumerated undoubtedly belong to the subkingdom Mollusca, and two of the Serpulids mentioned never burrow.

The genera *Stoa* and *Spirogyphus* are provided with a *multispiral* lid, which never is found in any Annelid. I have examined many specimens in spirit, which place it beyond doubt that these two genera belong to the Vermetidæ*.

I hope that this much-read journal will contribute to the exclusion of these two genera from the Annelids.

Abildgaard only states that he got two Serpulids from a surgeon, who extracted them from holes in the "marble rocks" and "chalk stones" below water on St. Croix. As the surgeon, on inquiry, asserted that they did not live in calcareous tubes, Abildgaard called them stone-borers.

I have examined numerous specimens of *Spirobranchus* (*Cymospira*) imbedded in coral, but I have never been able to discover any dissolving power of the Annelid. All specimens have been overgrown by the coral; but it seems that the *Serpula*, in the struggle for existence, is never completely imbedded before its death. Nor have I ever seen, in groups of *Serpule*, dissolved parts as in Vermetidæ. I doubt whether any tubiferous Annelid (*Serpula*) can burrow. I may add that Swammerdam (Biblia Naturæ, 1735, vol. i. p. 182, tab. ix. f. 15-17) has given an excellent account of an Annelid burrowing in *Littorina littorea*.

I am, Gentlemen,

Your most obedient Servant,

Copenhagen, Frederiksborggade,
November 29, 1868.

Dr. O. A. L. MÖRCH.

Contributions to the Fauna of the Gulf-Stream at great depths.

By L. F. DE POURTALES, Assist. U. S. Coast Survey.

The author introduces his paper, describing the species observed by him, with the following remarks.

The study of the constitution and of the inhabitants of the bottom of the sea is a field of research which has attracted the attention of

* Mörch, "Review of Vermetidæ," Proc. of the Zool. Society of London, 1861; and Journal de Conchyliologie, vols. vii. and viii. 1860, "Notice sur le genre Vermet."

naturalists in comparatively recent times. What Humboldt did with regard to the distribution of life at different heights in the atmosphere was done by Edward Forbes for the different depths of the ocean. The former's diagrams of the zones of vegetation on the slopes of the Andes are considered indispensable in every atlas of physical geography. But what one man could do where his glance embraced miles of country in height and breadth, and where the type of vegetation could frequently be recognized as far as the eye could reach, an investigator, even as zealous as Forbes, could but sketch in broad though happily drawn lines for the marine animals.

Much has been done in this direction since Forbes's death, particularly in England, where dredging has become a favourite occupation of many naturalists; the Scandinavian seas have also been explored with much success, chiefly by the Norwegian naturalists; but much more remains to be done in a field in which the areas to be explored can, as Jeffreys remarks, be reckoned in square degrees, whilst the research extends only over several square yards.

It is particularly in the greater depths, in the so-called abyssal region, that our knowledge is deficient. This is easily understood, since on many coasts the sea is comparatively shoal for a considerable distance from land, and the outfit for deep-sea dredging is beyond the means of all but a few private individuals. Government expeditions are generally fitted out for other duties, and can rarely devote their time to operations occasioning a delay of many hours. Furthermore, owing to the scantiness of the material, the impression generally prevailed, until recently, that animal life was soon reduced to a minimum with an increase of depth, or at least reduced to the lowest forms; so that the incentive of a rich harvest seemed denied to those who would have undertaken such researches.

Excepting the investigations of Dr. Stimpson on the coast of New England, the dredge has been as yet very little used along our shores. The character and constituents of the bottom are, however, pretty well known, thanks to the care of the late Superintendent of the Coast Survey, Professor A. D. Bache, who, during his whole administration of that work, required the hydrographical parties to preserve the specimens brought up by the lead. From eight to nine thousand specimens have thus been accumulated at the coast-survey office, from a region comprised between the shore and the outer edge of the Gulf-stream, and reaching nearly to 1500 fathoms. But of course, aside from the Foraminifera and Diatomaceæ, for the study of which this material has proved of high interest, not much was contributed to our knowledge of the animals of the higher classes, the instrument used being only adapted to procure a small quantity of sand or mud.

The present Superintendent of the Coast Survey, Professor B. Peirce, has lately directed the resumption of the investigations of the Gulf-stream, so successfully inaugurated by his predecessor, but interrupted for several years by the war. Besides observations of the depth, velocity, and direction of that current, and the temperature and density of the water at different depths, the researches will be extended to the fauna of the bottom, of the surface, and of the

intervening depths. Not only will an insight be thus obtained into a world scarcely known heretofore, but that knowledge will have a direct bearing on many of the phenomena of that great current. Thus a new light may be thrown on its powers of transportation from shallow to deeper water, or along its bed, on its action in forming deposits in particular localities, or on its possible influence on the growth of coral reefs on its shores.

The first campaign on this plan was organized in 1867, the field of research being in a section between Key West and Havana, incidentally with the purpose of sounding out the line for the telegraph-cable, shortly afterwards laid between these two points. The Coast-Survey steamer 'Corwin' was assigned to the work; and here I wish to express my thanks to my colleague, Assistant H. Mitchell, charged with the physical part of the campaign, and to Captain Platt and his officers for the interest they showed in my work, and for their valuable practical aid.

The expedition was unfortunately interrupted by the breaking out of yellow fever on board; so that the dredgings were few in number. However, short as the season's work was, and few as were the casts of the dredge, the highly interesting fact was disclosed, that *animal life exists at great depths, in as great diversity and as great abundance as in shallow water.*

The identifications of the species have been made by me at the Museum of Comparative Zoology at Cambridge, in the rich collections of which I have found abundant material for comparison; facilities of every sort were afforded me by Professor Agassiz, for which I wish to express my heartfelt thanks, as also for this opportunity of prompt publication.

The first dredgings were made on May 17th, on the Florida side of the Gulf-stream, about five miles S.S.W. of Sand Key, in depths varying from 90 to 100 fathoms, on a bottom of calcareous mud. The following list comprises the animals obtained:—

Articulatæ.—A number of small Crustacea were brought up, which have not yet been determined. They belong to the following or allied genera:—*Dromia*, *Iliu*, *Mithrax*? (a mutilated specimen), *Pagurus*, *Euphausia*, and *Orchestia*.

The tubes of several species of Annelids were obtained, but the animals were in most cases too defective for identification. The largest and best-preserved is *Morphysa floridana*, nov. sp. There are also tubes of one or more species of *Serpula*.

The Gephyreans are represented by *Sipunculus corallicola*, Pourt. (Proc. Am. Assoc. 1851).

Mollusks not determined specifically. These are mostly immature specimens or fragments of dead shells, and belong to the following genera:—*Murex* (dead), *Turbo*? (operculum), *Leda* (living), *Astarte* (living), *Tellina* (dead). Of Pteropods dead shells of the following species:—*Hyalea tridentata*, *Hyalea trispinosa*, *Cuvieria columella*, *Cleodora lanceolata*. The shells of this order are very common in deep-sea soundings. The Bryozoa are represented by *Vincularia margaritacea*, nov. sp.

Radiata.—Of Echinoderms were obtained an *Ophiurian* (an arm,

undetermined) and a number of specimens of *Comatula Hagenii*, nov. sp.

A *Zoanthus*, rather small, was obtained also, but, not having been noticed when alive, it would be somewhat uncertain to determine.

Hydroids: *Antennularia triseriata*, nov. sp.; *Thoa pulchella*, nov. sp.; *Th. capillaris*, nov. sp.

The Foraminifera had nearly all been washed out of the dredge; only the following were noticed:—*Textularia conica*, D'O. (very large); *Operculina (Spirillina) incerta*, D'O.; *Rotalina cultrata*, D'O.; and *Globigerina rubra*, D'O.

The total for this locality is therefore twenty-nine species, to which a few ought to be added for the undetermined fragments of Annelids.

No dredgings were had in mid-channel; this part had been reserved for the return trip; but the unfortunate interruption of the cruise prevented the execution of the project, at least for this season.

The next easts were obtained off Havana in 270 fathoms, on May 24th and 29th, on both days as nearly as possible on the same spot, as the little that was obtained at the first date had given much promise.

The results of the two easts are combined below:—

Articulates.—The Crustacea are not determined, but are of or near the following genera:—*Stenopus*, *Axia*, *Callianassa*, *Orchestia*, and *Idotea*, all living. Annelids: *Marphysa tibiana*, n. sp., and *M. antipathum*, n. sp. Tubes and fragments of four or five other species.

Of the *Mollusks* the Gasteropods and Acephala have not yet been determined, with one exception.

The following genera are represented:—*Mitra*?, *Fusus*, *Turbo*, *Emarginulina*, *Dentalium*, *Nucula*, and *Spondylus*, all dead; *Pedicularia decussata*, Gould, and a very small *Anomia*, both living. The Pteropods and Heteropods were all dead; they are:—*Hyalea trispinosa*, *affinis*, D'Orb., *gibbosa*, Rang, and *uncinata*, Rang; *Creseis spinifera*, Rang; *Cleodora pyramidata*, Pér. & Les.; *Spirialis rostrata*, Eyd. & Soul.; and *Atlanta Peronii*, Les. Of Brachiopods we obtained *Terebratulina cubensis*, n. sp., and *Terebratulina Cailletii*, Crosse; both living and apparently abundant. The Bryozoa are:—*Farcimia cereus*, n. sp.; *Vincularia margaritacea*, n. sp.; *Cellepora reticulata*, n. sp.; *C. sigillata*, n. sp.; *Canda retiformis*, n. sp.; *Canda cornigera*, n. sp.; *Idmonea flexuosa*, n. sp.

Radiata.—Echinoderms are represented by the following species:—*Spatangus* (dead, fragments); *Fibularia* (dead); *Cidaris annulosa*, Gray (probably, young, living); *Tripneustes ventricosus* (living, very young); *Asterias*, sp. (very young, living); *Ophiurians*, at least three species immature and difficult to determine; *Comatula brevipinna*, n. sp., living; *Pentacrinus*, sp. (fragments of stem, among which some appear quite fresh).

Of Zoantharia the following were brought up:—*Antipathes humilis*, n. sp.; *Antipathes filix*, n. sp.; *Acanthogorgia aspera*, n. sp.; *Gorgonia exserta*, Ellis; *Swiftia exserta*, Duch. & Mich.; *Hyalonema* (spicules); *Caryophyllia formosa*, n. sp.; *Deltocyathus Agassizii*,

n. sp.; *Stylaster complanatus*, n. sp.; *Errina glabra*, n. sp.; *Errina cochleata*, n. sp.; *Crypthelia Peircei*, n. sp.; *Distichopora sulcata*, n. sp.; *Heliopora? tubulata*, n. sp.; *Heliopora? carinata*, n. sp.; *Isis?* (base of stem); *Sarcodictyon rugosum*, n. sp.

Hydroids: *Thoa pulchella*, n. sp.; *Tubularia crisiis*, n. sp. Foraminifera: *Lagena striata*, Mont., rare; *Nodosaria pyrula*, D'O., rare; *Dentalina communis*, D'O., rare; *D. (agglutinans?)*; *Lingulina carinata*, D'O.; *Textularia trochus*, D'O., common, very large, also abundant in shoaler water; *T. agglutinans*, D'O., rare; *Nonionina scapha*, rare; *Nonionina umbilicatula*, Montg., rare; *Cristellaria crepidula*, F. & M., rather common; *Orbiculina adunca*, D'O., rare and only in a worn state; its proper habitat is in the littoral zone; *Amphistegina gibbosa*, D'O., rare, and only young specimens; it is very common throughout the Gulf of Mexico in deep water; *Globigerina rubra*, D'O., very abundant, also in the *Orbulina* form; *Gl. Dutertrei*, D'O., common; *Pullenia obliquiloculata*, P. & J., rather common; *Pullenia coarctata*, n. sp., rather common; *Spheroidina dehiscens*, P. & J., not common; *Rotalina cultrata*, D'O., very common; *Rot. truncatulinoides*, D'O., common; *Rot. Poeyi*, D'O., rather common; *Rotalina*, two other species in single and imperfect specimens; *Biloculina*, sp.; *Triloculina Brongniartiana*, D'O., rare; *Quinqueloculina bicostata*, D'O., rare.

Many of the specimens of Foraminifera are filled up with a yellow mass, like the first stage of transformation into greensand; but the process seems to stop here.

Of sponges quite a number were obtained, at least a dozen species, which have not yet been determined. Some of the detached spicules are remarkable for their size—one, for instance, of the slender rectangular sexradiate type of Bowerbank measuring more than half an inch.

The vegetable kingdom was represented in this dredging by a single specimen of a minute alga, *Centroceras clavulatum*, Agardh, which Harvey says was found abundantly at low-water mark at Key West. In its branchlets was entangled a chain of a species of *Biddulphia*. Other Diatoms are rather scarce and have not yet been determined. We therefore find here, also, a confirmation of the remark made in European seas, that vegetable life does not extend to depths as great as are reached by animals, and that, therefore, the greater number of deep-sea animals must be carnivorous.

The dredge contained also a number of nodules of a very porous limestone, similar in colour and texture to the limestone forming the range of low hills along the shore of Cuba, but composed apparently of the remains of the same animals which were found living. Thus our *Deltocyathus*, *Caryophyllia*, the various Pteropods were recognized in the stone, and found also in various stages of fossilization. The interstices between the larger forms are generally filled up with Foraminifera.

On May 25th the dredge was sent down in 350 fathoms, outside of the locality occupied on the 24th and 29th. It brought up only a few dead corals—*Caryophyllia formosa*, *Deltocyathus Agassizii*, *Diplohelia profunda*, the latter in numerous specimens,—also a

fragment of the siliceous skeleton of a sponge, forming a regular network somewhat like that of *Euplectella* as figured by Bowerbank, but lacking the spines.

The soundings made during the cruise seem to indicate a kind of submarine terrace, on which the dredgings of the 24th and 29th were made. The cast of the 25th was probably made on the edge of it; and the dredge no doubt touched bottom only for a short time, after which the ship drifted off into water too deep for the line attached.—*Silliman's American Journal*, November 1868.

Deep-sea Dredgings in the region of the Gulf-Stream.

By L. F. DE POURTALES.

I sent you a few days ago a small pamphlet* containing some of the results of the deep-sea dredgings made by me in connexion with the exploration of the Gulf-stream by the Coast Survey. If you think it worthy of notice in the 'Journal of Science,' I have thought it would add to the interest to mention the much more complete results of this year's campaign, which were the subject of a brief communication I made to the late meeting of the National Academy at Northampton. As the specimens have not all been determined as yet, I can give here but a short outline.

The dredgings were made outside of the Florida reef, at the same time as the deep-sea soundings, in lines extending from the reef to a depth of about 400 to 500 fathoms, so as to develop the figure of the bottom, its formation and fauna. Six such lines were sounded out and dredged over, in the space comprised between Sand Key and Coffin's Patches. All of them agree nearly in the following particulars. From the reef to about the hundred-fathom line, four or five miles off, the bottom consists chiefly of broken shells, and very few corals, and is rather barren of life. A second region extends from the neighbourhood of the hundred-fathom line to about 300 fathoms; the slope is very gradual, particularly between 100 and 200 fathoms; the bottom is rocky and is inhabited by quite a rich fauna. The breadth of this band varies from ten to twenty miles. The third region begins between 250 and 350 fathoms, and is the great bed of Foraminifera so widely extended over the bottom of the ocean.

The second region is the most interesting, from the variety of animals inhabiting it. The bottom rock, of which many pieces were brought up, is a limestone, still in progress of formation from the débris of the shells, corals, &c. growing and dying on its surface. In this fauna the vertebrates are only represented by a very few small fishes, and those not deeper than 100 fathoms. But all the branches of invertebrates are represented; I will mention the most characteristic. Of the Mollusks, the most common is *Terebratul* *evbensis*, mihi, and a new species of *Waldheimia*, both of large size. Of the former, more than a thousand specimens, and several hundred of the latter, were collected. Gasteropods are rarer and mostly small, the largest being the *Voluta junonia*, which was

* The article above noticed,